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Optimization of noble metal nanostructured substrates for SERS.

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Surface Enhanced Raman Spectroscopy (SERS) is a very powerful technique for structural characterization. In order to study this phenomenon nanostructured substrates are needed, and in particular those made with Cu, Ag or Au metals deposited on glass. In this work their synthesis by laser ablation and the characterization by UV-visible spectroscopy, Transmission Electron Microscopy (TEM) and SERS are reported. A Nd: YAG laser emitting in the third harmonic, at a wavelength of 355 nm and a pulse duration of 10 ns has been used as energy source. Nanostructures are made by varying the number of pulses typically from 200 to 20000 using about 100 mJ as output laser energy and focused in a spot of 1 mm in diameter in the corresponding target. The different morphologies were characterized and their SERS signal was measured using methylene blue as test molecule. The surface plasmon wavelength strongly depends on the nanostuctures morphology; evolving progressively from nanospheres to more intrincate shapes such as bean or worm-like features. It is found that the SERS signal increases monotonically with the size of the Ag, Au, Cu nanoparticles until reaching a maximum in intensity and subsequently decreases. The maximum in intensity occurs for a quasi-percolated film (worm-like features), this behavior will be analyzed in terms of the "hot spots"theoretical approach.

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